

**U.S. ENVIRONMENTAL PROTECTION AGENCY
PROPOSED STUDY OF HYDRAULIC FRACTURING**

SUMMARY OF PUBLIC COMMENTS

September 2000

(#) = number of commentators

Following is a summary of comments received at a public meeting held on August 24, 2000, by attendees and telephone participants, as well as a summary of written comments submitted by interested parties. This summary also covers presentations made by scheduled speakers and major points expressed by commentators.

Summaries of presentations made by the scheduled speakers:

Ms. Connie Bosma, Acting Chief, US EPA OGWDW, DWPD, introduced herself and Ms. Leslie Cronkhite, study Project Manager. Ms. Bosma noted that the objectives of the meeting were to obtain comments on the study design and provide a forum for input on the hydraulic fracturing (HF) study. She provided the following background on the study.

In 1994, the Legal Environmental Assistance Foundation (LEAF) petitioned EPA to withdraw Alabama's program because Alabama did not regulate hydraulic fracturing as part of its underground injection control (UIC) program. EPA denied this petition. EPA had historically not considered hydraulic fracturing as underground injection. LEAF then sued, and the 11th Circuit Court ruled in favor of LEAF saying that HF is indeed underground injection. In 1999, HF regulations were adopted by the State of Alabama and approved by EPA. LEAF has since challenged EPA's approval, and EPA is now awaiting the Court's ruling on these challenges. All this activity raised the visibility of hydraulic fracturing, and, subsequently, a group began to seek legislative relief on Capitol Hill in the form of legislative changes to exclude HF from the UIC Program. EPA indicated at numerous Congressional hearings and meetings that it believes further investigation is necessary to evaluate the potential risk before any regulatory decisions are made. EPA is now undertaking a study to help in that determination. EPA has met with industry representatives, states, and Congress. In 1999, the Ground Water Protection Council (GWPC) performed a study and a survey of state oil and gas boards on HF, and EPA will be using this study as one of its sources of information.

Ms. Bosma then explained EPA's purposes for this meeting are to gather input on the study design, allow the public an opportunity to offer information on HF, and provide EPA technical

expertise in formulating the study. She acknowledged EPA's study design is very brief and will be modified based on the comments taken from the public. Ms. Bosma underscored that this will not be the last time for meeting with the group. EPA would like stakeholder input on how it can continue to meet with the group and get input during the progress of the study.

Ms. Bosma went on to clarify that the meeting is not a discussion of what qualifies as underground injection, whether or not HF should be regulated, whether or not legislation is necessary, or whether or not EPA should do the study. EPA has decided to do the study. It now wants stakeholder's comments on whether EPA is on the right track and, if not, what track it should be on to complete the study.

Ms. Susan Nickerson of Horsley & Witten, Inc. introduced herself and Dr. Chi Ho Sham of Tetra Tech EMI, Inc. as the day's facilitators. Ms. Nickerson described the meeting agenda overview and named the public commentators who had slide presentations to give. An overhead projection with a list of speakers was shown and instructions given to speakers. Ms. Nickerson reiterated that comments should be limited to the design of the study rather than its merits. She noted that there would be time at the end of the day for open discussion on issues other than the study design.

Ms. Leslie Cronkhite then took the podium. She said EPA had prepared a study design to convey EPA's ideas on what might be included in the study. In that design, EPA listed information it believes important to gather in assessing potential problems, if any, with HF. She highlighted some of the points in the study design, and noted that EPA plans to focus on coal bed methane wells, specifically, and on UIC and ground water issues, as opposed to surface water issues related to coalbed methane production.

Ms. Cronkhite showed a timeline of the study schedule. According to EPA's proposed schedule, the agency would gather information between Fall 2000 and Spring 2001; review and analyze the information, and prepare a draft report by Fall of 2001; submit the draft report for stakeholder comment; and, depending on the nature and extent of the comments, have a final report in early 2002.

Ms. Cronkhite noted that one of the key points in the study design would be surveying drinking water agencies. This work would build on the survey that the GWPC prepared in 1998. GWPC conducted a survey of oil and gas boards in states with coal bed methane wells. EPA wishes to survey state agencies that deal with drinking water specifically, because members of the public may bring complaints and issues with ground water to those agencies. If EPA finds any incidents based on that survey, it would do an investigation into those incidents. EPA may ask to review industry records of reported incidents, in cases where an oil and gas board has handled those incidents. EPA also proposed a literature review. EPA proposed collecting information on state regulations. Once EPA has gathered the necessary information, the agency may conduct a risk characterization.

Ms. Cronkhite summarized the nature of alleged reports on drinking water wells from HF activities as:

- methane contamination and/or hydrogen sulfide;
- discoloration of water seen a couple of days after a hydraulic fracturing event has occurred nearby;
- a soapy discharge coming out in water; and
- a diesel taste to water a day or two after an HF event.

Ms. Cronkhite noted that some complainants expressed concern that their wells had been affected permanently, while other experiences were transient. EPA has also been notified of water loss problems in drinking water wells. EPA has received reports alleging problems associated with HF from Virginia, Colorado, and New Mexico. Since it published the Federal Register notice, EPA received calls from Texas, Pennsylvania, and California.

The proposed literature review would investigate fracturing technology, instrumentation technology, and geology and hydrogeology of areas where coalbed methane development is likely to occur. EPA would look at water usage in these areas and produce a report presenting all the information on methods of data collection and analysis, risk characterization, and EPA's conclusions. This report would be available in draft for comment.

Ms. Cronkhite noted that comments would be taken on the study design, but also on continued stakeholder involvement. EPA wants to keep stakeholders involved during the study. EPA plans to establish a website to allow for continued dialogue. Ms. Cronkhite noted that this initial conceptual study design would be followed by a detailed study methodology, which will incorporate stakeholders' comments. EPA suggested the detailed study methodology will be posted on the Internet for review and comment. She EPA contact information was given as follows:

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Ms. Leslie Cronkhite
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Presentation by Dr. Peter Warwick, United States Geological Survey (USGS):

Dr. Warwick reviewed work the USGS is doing in the area of coalbed methane resources, and provided background on what coalbed methane is and how the USGS views it. He started his talk by describing the USGS energy program. It is part of a larger organization that covers earth

science in general. Its job is to assess the energy resources of the country and the world, as the United States is dependant largely on imported energy sources. The USGS has developed models for the occurrence, distribution, and quality of these energy resources.

Dr. Warwick showed a map of the U.S. with colored areas showing where coal occurs, and thus where coalbed methane occurs. All coal has methane in it. Some coal has more, some less. Coal occurs in a large part of the U.S. There is active production in the Appalachian region, in the central part of the country, a lot in the western states. USGS is now working on the Gulf Coast to see what potential that area might have. The Cook Inlet in Alaska has large resources. Dr. Warwick noted that rank of coal is very important. The higher ranked coals are usually tighter with higher gas content. The lower ranked coals also have gas but at a lesser concentration.

In 1995, the USGS assessed the coalbed methane resources of the U.S. In the last five years, coalbed methane production activity has developed quite rapidly, and the USGS is currently working on a new assessment for the country. In 1995, coalbed methane was assessed at about 50 trillion cubic feet, which was about 4.6 % of the total gas resource of the country. At that time, the USGS said that coalbed gas was a small percentage of what the country's endowment of gas would be. The latest statistics from the National Petroleum Council suggest that 6% to 8% of the national production will be from coalbed methane.

Dr. Warwick then spoke about a diagram indicating that the deeper a well goes, the less the permeability. He noted that gas removal at depths greater than approximately 6,000 feet is extremely difficult. A window from near the surface to approximately 4,000 to 6,000 feet deep is where gas is going to occur. Another diagram compared time of production activity and volume recovered. In a coalbed methane well, a lot of water is produced at first. Then, water production drops and methane production increases. Gas production eventually declines toward the end. The time scale is years to decades.

Dr. Warwick showed a graphic of a coalmine in Texas depicting complex stratigraphy. He discussed coals of varying ranks and where they occur. In low ranked coals, like in Powder River or the Gulf Coast or some of the Alaska fields, there is no fracturing or injection involved. Gas is simply pumped.

In more complex zones where the coals are harder, fracturing is necessary. Water or other materials are injected into the zone around the well bore to loosen up the coal so gas can flow out through the pipe. This activity raises questions concerning the kind of fracturing performed. For example, are there multiple or single zones, and what kind of materials are put in the fluids to hold the cleat space open and get the gas out. For example, do you use, water, gels, viscous fluids, or sand? Choices vary from basin to basin, field to field, and well to well. Every basin has its own complex geology, so the techniques employed to produce gas change from basin-to-basin.

Dr. Warwick mentioned a new technology, horizontal drilling, where drilling is done sideways. This approach is becoming quite economical, and is currently being used in Oklahoma.

Finally, Dr. Warwick discussed coalbed methane production around mines. This activity involves drilling into leftover underground mines, or in advance of mining, to reduce the gas content for safety. Some examples were given.

Dr. Warwick went on to describe work being done by USGS to identify resources of various areas of the country and the kind and extent of gas deposits. In particular, he discussed the San Juan basin, in the Colorado plateau, and Powder River, in Wyoming/Montana. He mentioned that in Wyoming, the number of producing wells was less than a few hundred in the early years of production, and, within the last few years, has gone up to over 1,200 wells. Production has gone up considerably as well.

Dr. Warwick described a quick survey he did of the literature to show the amount of water produced from a number of wells compared to the total dissolved solids in that water. He said 1,000 to 1,200 barrels of water are produced per day in some basins. He concluded there is large variability in the TDS of the water coming out of these wells. Some of the water is of drinking water quality and some is not.

Dr. Warwick also mentioned the potential for introducing CO₂ produced from power plants back into the coal beds, and then pressing the methane out. This technology is being studied.

During the question and answer period, Dr. Warwick said there are a lot of differences around the country in the type of coal that occurs. Older coals (carboniferous coals), found in the Appalachians and the central part of the country, are basically hard. These coals need fracturing to help get the gas out. The coals in the Gulf Coast, the Powder River Basin, North Dakota, and in younger coalfields, are soft and the gas comes out quite freely. Due to their permeable nature, a lot of water must be produced. No fracturing takes place in these locations. Harder coals are usually quite deep. The maximum depth for coalbed methane production is approximately 6,000 feet. Harder coals are found mainly in the range of 2,000 to 3,000 feet. Coals do come to the surface, depending on the basin situation.

In response to a question regarding tight sand or tight formations, Dr. Warwick said there are large areas within the country that have shales, and as with the coals, the shales have gas within them. These are continuous gas-type deposits. Companies are now looking at tight shales for potential gas production.

A member of the audience suggested that the USGS review information through its water resources division regarding naturally-occurring gas in water. He thought USGS could contribute this information to EPA as it studies the occurrence of methane gas, to see if there is a standard or baseline for gas in USDWs outside of coalbed development areas.

Dr. Warwick agreed and noted that methane gas occurs in just about all ground water systems. Therefore, especially in coalfields, gas is likely to occur in wells.

Dr. Warwick was asked if USGS has sufficient information to lead to the geological and hydrological portions of EPA's proposed study. The speaker thought that if USGS has already answered all of the questions EPA seeks to answer in this study, USGS could just contribute the information to EPA.

Dr. Warwick responded that USGS has a large database on water resources, water systems, coal, and the occurrence of coalbed gas, and that USGS could help.

Presentation by Peter Lagiovane, Office of Fossil Energy, US Department of Energy (DOE):

Mr. Lagiovane stated that further regulation of hydraulic fracturing (HF) can have serious implications on national energy policy. He commented that the regulation of HF can have significant detrimental impacts on natural gas production and the future of domestic natural gas production. On behalf of the DOE, especially the Office of Fossil Energy, Mr. Lagiovane said that the proposed EPA study must examine demonstrated facts, and be based on good science. He noted that natural gas production in the United States is increasing dramatically and is the preferred fuel for electricity generation. Mr. Lagiovane explained that HF increases methane gas recovery dramatically and is critical to maintaining and increasing volumes. In addition, he referred to a report, Environmental Benefits of Advanced Oil and Gas Exploration and Production, that shows that HF reduces the need for drilling additional wells. Mr. Lagiovane provided the reference for the report, and noted that it is available on the DOE Website: www.fe.doe.gov, or in hard copy from 202- 586-8116.

Mr. Lagiovane offered his opinion that the potential impact of regulation can already be seen in Alabama. He notes that regulation of HF at all could have a dramatic impact on the gas market. He stated that the U.S. can't meet its energy demands or environmental objectives unless it can produce adequate, affordable natural gas. Considering the extensive data already available, Mr. Lagiovane felt that the EPA study can be completed quickly and it isn't necessary to extend the process for nearly two years. The DOE strongly believes that the study should be confined to HF of coalbeds only. Mr. Lagiovane emphasized that any information used to justify expanding the study must be factual, site specific, and scientifically verifiable. He stated that the DOE is anxious to work with EPA to share its technical expertise on the subject.

SUMMARY OF COMMENTS

The following text summarizes major points expressed by commentators. It is divided into 10 major sections.

1. MEETING LOCATION AND FORMAT

A few commentators expressed an objection to Washington, DC, as the location for the meeting, citing prohibitive travel costs, and suggested that future meetings be held in closer proximity to coalbed methane (CBM) activities. Another commentator felt that the agenda and scope of meeting had changed from that described in the Federal Register Notice. *(1)*

2. REGULATION OF HF FOR CBM WELLS

The following concerns were raised regarding the impact of regulation on natural gas production:

- significant detrimental impact on domestic natural gas production and its future and affordability; *(2)*
- risk to efficient recovery of a non-renewable resource; *(1)*
- risk to maintaining and increasing volumes of methane production; *(2)*
- potential for making exploration projects uneconomical; *(1)*
- impact on ability of nation to meet environmental goals to produce clean, domestic, energy resources; *(3)*
- hydraulic fracturing is an essential component for any CBM commercial production;
- cost to states in absence of federal funding; *(2)*
- necessity of HF as a completion technique or the likelihood that it merely creates larger fractures that increase the rate of gas recovery and thus profits; *(1)* and
- the potential for HF to disrupt the natural fracture pattern, resulting in the need for more gas wells. *(1)*

One commentator noted that Congress has facilitated development of CBM. Another felt that industry is out of control and that environmental assessments should be required prior to extraction activities. *(1)*

3. ENVIRONMENTAL EFFECTS OF HYDRAULIC FRACTURING

Commentators expressed a number of opinions on this matter. Several stated that there was no evidence that HF has resulted in contamination or endangerment of underground sources of drinking water (USDWs) *(16)*. They questioned how many reports of contamination had been received by EPA *(2)*, whether state agencies had been notified *(2)*, and whether reports had been substantiated. *(2)* Essentially these commentators wanted to establish the validity of the claims.*(2)* They went on to say that practices are already in place (e.g., cement casings) that make contamination impossible, and that liability considerations for drinking water contamination ensure that operators take necessary precautions.*(2)* One commentator stated that it is impossible to intersect a fresh water aquifer above or below the coal in shallow wells; material can only be fractured in a plane perpendicular to the axis of least principle stress.*(1)* Some commentators were concerned that primacy of state underground injection control (UIC) programs is in jeopardy due to alleged contamination incidents which they believe have no

basis.(2)

Proponents of HF stated that the procedure reduces the need for drilling additional wells, thereby reducing the amount of drilling waste requiring disposal, and precluding the need to drill new wells in the same formations.(1) They noted that the technology is continually changing and improving, and underscored the relationship of CBM development to clean air.(2) Some also mentioned that HF is a valuable technology for drinking water well development.(1) One commentator explained that fracturing water wells is not the same situation, in most cases, as fracturing a mineral producing zone.(1)

One commentator stated that if HF is successful, the injected fluids are recovered along with other fluids from the reservoir, hence no environmental damage.(1) If the HF is unsuccessful, the injected fluids remain trapped in impermeable rock, hence no environmental damage.(1) A number of commentators stated that HF fluids and gelling agents are safe.(3) CBM fracturing fluids are designed specifically for each application.(1) Several commentators stated that the majority of HF activities take place at depths far below ground water that could reasonably be considered an underground source of drinking water.(3)

Other attendees felt extensive ground water contamination has taken place due to HF, and that many people are currently affected by poor water quality.(6) Reference was made to the hazardous nature of the fluids and gelling agents used in HF.(1) Bureau of Land Management (BLM) documents have identified benzene, toluene, ethylbenzene, methyl tert-butyl ether, naphthalene, PAHs, and xylenes among other chemicals in these fluids.(1) Some commentators noted reports of hydrogen sulfide in home water systems and a buildup of methane in the crawl spaces of homes in areas of CBM.(2) Requests to industry and government agencies for full disclosure and analyses of HF have gone unanswered.(3) One commentator questioned the integrity of the industry.(1) Some questions raised concerning potential geophysical impacts were:(1)

- Since HF shakes houses and disrupts normal water well production, how does the fracturing affect other geological formations outside of the target formation?
- Can intentionally created fractures extend outside of the targeted formation?
- What level of control does an operator have over the migration of a hydraulically-created fracture?
- Does the energy released during an HF operation threaten the structural integrity of other formations, especially shallower aquifers used for drinking water?
- Can HF aggravate migration of methane into drinking water supplies by enhancing the natural fracture systems that link the coalbeds to the surface?

Questions raised concerning chemical composition included:(1)

- What types of chemicals, common and experimental, have been used in HF?
- What types of chemicals, common and experimental, have been used in acid fracturing?

- What other types of fracturing techniques are available?
- What are the range of quantities used for each type of chemical?
- Do less damaging alternatives exist?

Issues raised concerning human health and environmental impacts included:(1)

- the recovery rates of injected fracturing materials;
- the range of quantities of fluid loss during fracturing;
- the environmental and human health effects of fracturing materials;
- the bioaccumulation effects of remaining fracturing fluids in subsurface ecosystems;
- the synergistic effects of fracturing materials with other materials (natural and introduced) associated with coalbed methane development;
- the rates and consequences of the biodegradation of remaining fracturing materials;
- the destination of fracturing wastes after the wellbore is “cleaned;”
- waste by-products created by fracturing;
- the availability of technologies to reduce and eliminate fracturing leakoff into natural fissures;
- the effect of wormholes on loss of fluid into thief zones and natural fissures during fracturing operations; and
- the existence or lack of ecotoxicology reports produced on fracturing.

Commentators suggested that cumulative impacts of HF need to be addressed and a complete NEPA analysis and disclosure conducted.(2)

4. ROLE OF STATES

Several commentators felt that EPA should partner with others on the HF study, and that such partnerships should include DOE, USGS, state drinking water entities, oil and gas (O&G) agencies, and EPA regional offices.(5)

Some commentators felt that the states’ regulation of HF is adequate to protect ground water, that state O&G regulators and their programs are creditable, and that EPA was not giving any weight to the decades of experience of the states.(6) Some in the audience had concerns that the EPA assumes that states are not capable of doing an effective job.(2) One industry representative said that EPA should not go below the state level to investigate incidents of alleged contamination.(1)

Several commentators mentioned complaints by citizens and environmental groups of inadequate response by states to incidents.(5) They said that citizens don’t have the resources or time to pursue a satisfactory response from state agencies.(1) One commentator mentioned that if O&G companies are contributing to ground water contamination, there may be a link for the Superfund program to become involved.(1)

Some commentators criticized EPA’s regard for Clean Water Act (CWA) and Safe Drinking

Water Act (SDWA) requirements, saying that the proposed study is inconsistent with the Congressional intent of the SDWA(2). The suggestion was made to remand the study to the states.(1) Another suggestion was made for EPA to work with stakeholders and Congress to enact an amendment to the SDWA that exempts HF and other well drilling, workover, and completion activities from the UIC program, or, alternatively, promulgate a permit-by-rule for such activities.

A number of commentators wanted states to investigate alleged incidents and report their findings to EPA.(2) They said that EPA should share all of the details of information it has gained about ground water contamination with the states, so that states could pursue the validity of allegations and take any appropriate corrective measures.(2)

One person wanted to know, other than Alabama, where HF of CBM wells is required to be included in a state's UIC program.(1)

One commentator felt that collusion exists in some states between legislators, regulators, and gas producers to obscure the problems with HF.(1)

5. TIME FRAME OF STUDY

A number of comments were received on the length of the study. Many felt that two years was too long to conduct the study.(5) Industry wants to see the time frame accelerated so it can continue to increase production.(1). One commentator urged EPA to conduct the study swiftly due to large numbers of CBM wells currently producing, and the number of wells projected for the near future.(1) One person suggested that states give a detailed summary of their experiences to EPA in order to speed the study process.(1)

Some commentators called for the study to be carried out in discrete phases in order to help define the scope and eliminate later events that may be unnecessary, based on the results of preliminary phases.(2)

One commentator said EPA should document its findings in a preliminary final report summarizing all phases, and drawing conclusions.(1) This draft report should be made available for public review and comment.(1) Also, EPA should clearly identify its conclusions relative to the purpose or goals originally laid out for the study.(1)

Several commentators said the study should take time and do a thorough job.(2)

6. STUDY DESIGN

A number of commentators questioned the need for the study, asking whether it was the appropriate mechanism to address HF concerns.(5) The anecdotal nature of existing information was cited.(3) The point was made that no investigations have been published to examine the

relationship of completion and production activities to contamination or depletion of domestic water supplies.(1)

Some commentators asked what the specific goals and terms of the study were.(5) One person wondered if EPA has a different purpose in this effort, one that is inconsistent with the facts at hand.(1) It was noted that Congress never intended to regulate HF under the SDWA.(1) Another person urged EPA to consider the benefits of CBM production.(1)

Several commentators said the GWPC 1998 survey and analysis should be built upon instead of conducting the EPA study.(3) One commentator stated that the study should identify how it will differ from the GWPC survey and the newly-proposed GWPC resurvey.(1)

Several commentators felt that the study assumes there is a problem with HF, that it is geared towards finding a problem, and that it is an overreaction to complaints.(6)

Statements were made that the study ignores information previously provided by states and other parties, and members of Congress, that methane gas production from coalbeds does not result in contamination and/or water loss from underground drinking well sources.(3) Some people stated that the study needs to be objective.(3)

Regarding the scope of study, many commentators said it is too broad. The following points were made by several parties:

- study design needs to be more focused;(5)
- scope should be narrowed to the issues covered by the US Court of Appeals 11th Circuit;(2)
- scope should be confined to HF of CBM wells only;(9)
- study may unjustifiably expand to additional fracturing methods;(1)
- initially, scope should be limited; consider possibility of future, separate, phased studies in additional areas if warranted;(1)
- criteria should be defined at outset that would be used to determine if expansion of the study is warranted;(1)
- basis for study (AL situation) is not applicable to all other known CBM situations (e.g. Utah);(1) and
- dewatering of CBM wells is a production issue, not an HF issue and, as such, is outside the scope of the proposed study.(2)

Other commentators addressed the need to account for geological and geographical variations. They said the study must:

- look at various geologic and hydrogeologic settings;(3)
- compare similar settings with and without HF;(2)
- look at other formations with natural fractures (not just coal bed areas);(1)

- clearly establish where the study will be focused geographically;(2) and
- establish the extent of quantifiable contamination.(2)

Some commentators urged EPA to expand the scope of study to later include traditional O&G operations.(3)

The issue of water use, loss, or disposal was addressed by several commentators, who stated that:

- EPA’s authority does not extend to water loss incidents;(3)
- water loss is not covered by the SDWA and confuses the target issue of the study;(1) and
- water use and disposal is best studied and evaluated on a local and regional basis as water needs and policy differ widely.(1)

However, other commentators stressed the concern that HF has led to water loss and that EPA should take action regarding this matter.(3)

On the subject of the survey of existing regulations, one commentator stated that if EPA is considering regulation, one common regulation is not appropriate for the entire industry. Rather, regulations should be based on geological areas or state regulations.(1)

The need to investigate incidents outside CBM areas as well as inside was mentioned, and it was pointed out that methane has occurred in domestic water supply wells outside CBM areas. Another person said that gas already exists in the aquifers and HF doesn’t impact its movement one way or the other.(1)

Another point made regarding the study design was that it should clearly state that the investigation of “incidents” is restricted to citizen complaints alleging contamination by hydraulic fracturing of CBM wells.(1) The commentator was concerned that EPA uses the terms “incidents” and “alleged incidents” interchangeably.(1) EPA should consistently use the phrase “alleged incident” when referring to citizen complaints that have not been comprehensively evaluated to determine the cause of contamination.(1)

It was noted that the UIC program falls within the SDWA program so its primary objective is the protection of public water systems.(1) A question was raised regarding the goals of the study: Are impacts on public water systems the target of the study effort, or will it be broader, or more narrowly defined?(1) A concern was raised about a major expansion of the UIC program. One commentator wanted to know what level of environmental risk to underground water supplies and potential receptors will trigger further study beyond the current proposal by EPA and thus expand the UIC program.(1) In addition, the question was raised as to what levels of regulatory effectiveness will be considered acceptable.(1)

One commentator recommended a phased approach to the study that includes:(1)

- collection/evaluation of incidents, calculation of incident rate: issue interim report;
- collection/evaluation of existing state regulation of HF: issue interim report;
- collection of data on potential risk factors and how they could be addressed in regulation to reduce risks/incident rate; and
- develop preliminary final report based on all data evaluated and stakeholder review of interim reports.

Considerable discussion took place on the literature review section of the study. Commentators felt that EPA should:

- focus on problem identification, not literature studies;(1)
- evaluate the literature on CBM fracturing practices and risk assessment after an initial phase assessing whether there is indeed a problem;(2)
- initiate the study as a coordinated partnership with the states to obtain information regarding regulations and existence of contamination or water loss from CBM wells, prior to literature review;(1)
- acknowledge that a literature review alone cannot elucidate the effects of HF on the diverse and separate basins across the country;(1)
- confine the literature review to documented contamination incidents;(1)
- rearrange the study to do a literature review before data collection;(3)
- give more credence and weight to recent studies and information since technology of HF has advanced significantly in recent years;(1)
- reject information on practices that are outdated or no longer in general use, or not considered an appropriate technology for current application;(1)
- consider that a survey of the geologic literature will not scientifically evaluate either potential or actual risks in a CB reservoir;(1)
- consider that a literature review will not provide an understanding of the different coal basins with regard to their individual relationships between geology, hydrogeology, reservoir, and aquifer characteristics;(1)
- examine and evaluate literature related to HF of water wells;(1)
- conduct more than a literature review of the composition of HF fluids, and identify the full range of actual fluids used throughout the industry;(1) and
- indicate how EPA will consider, review, and integrate the extensive body of scientific literature into its study design.(1)

The following comments were submitted regarding review of instrumentation technology:

- a study of HF techniques should include an historical review of the development of fracturing and its importance;(1)
- in performing its review of the technology, EPA should also evaluate sources of literature within the Agency and DOE on the current use of fracturing above pressure gradient for the disposal of large volumes of wastes from Superfund sites and federal facilities (to the extent that this literature describes potential risks and how they are managed);(1)

- EPA must confirm that the references it relies on reflect current practice;(1)
- CBM production is characterized by strong regional differences with different appropriate technologies;(1) and
- EPA should consult with the three companies that perform virtually all of the HF in the US (BJ Services, Halliburton, and Schlumberger).(1)

One commentator urged use of existing surveys and a review of best practices from the various industries related to HF be included as a component of the study.(1)

API offered its assistance to EPA in translating technical terminology in the literature.(1)

Other commentators said that without narrowing the parameters of the survey, the study may become time consuming and costly, and that a full-blown human health risk assessment is not worth the cost, time, or effort for the very low problem incident rate that may be documented.(2)

One commentator noted that it is fairly easy to identify where injection wells are injecting out of zone with temperature and or tracer logs, therefore this expensive study is unwarranted.(1)

Several commentators questioned the scientific rigor of the study and called for revisions that would ensure credible assessment of the risks to source waters posed by HF.(3) The need for peer review of the study design and any draft report was emphasized.(4) There was concern that the results will be based on subjective opinion.(2) EPA must establish standards for “incidents” and “alleged incidents.”(1) Standards for the basis of development of new regulations are not included in the study design.(1)

One commentator said the study promotes a course of delay and misdirection, and that they had no confidence in EPA’s ability to conduct unbiased research on the HF process or deliver the findings in an objective manner.(1)

Other comments on the conduct of the study were that :

- EPA should define who will be involved in the study and what their qualifications are relative to the evaluation of hydrogeologic, hydrochemical and engineering data;(1)
- a control study of a non-coalbed area with a similar hydrogeology and geology and naturally occurring fractures should be included;(1) and
- statistical techniques should be applied to determine if there is any significance to differences in incident rates in CBM areas with HF, CBM areas without HF, and a control non-CBM area.(2) Whenever variables are not constant between study areas, these dissimilarities should be duly noted.(1)

Regarding peer review, commentators had the following remarks:

- in addition to peer review, a review panel of experts within the industry is needed;(2) and

this panel should have input into the study as the draft is produced and the study is conducted;(I)

- peer review should be explicitly sought from USGS and National Research Council;(I)
- at a minimum, peer review should be conducted after refining the initial study design, after any field studies, after selection of the risk model, and prior to issuance of any final report;(I) and
- there needs to be an oversight group (regulatory and industry mix) to review and critique the study in each phase.(I)

Commentators had the following thoughts on the assessment of existing regulations and legislation:

- EPA should work closely with state O&G regulatory agencies and not just search the text of regulations given the variety of approaches of states;(I)
- EPA should work with GWPC and IOGCC;(I)
- EPA should examine both existing protections for ground water and any specific requirements related to HF;(I)
- many states impose requirements that are not spelled out in specific regulations, but are provided on a case-by-case basis with the approval of each permit;(I) and
- at the conclusion of this phase of the study, EPA should document its findings and issue an interim report for public comment. EPA should indicate whether it finds existing state regulation to be adequate to address the risks of HF indicated by incident rate. If EPA finds an isolated problem, it should consider working with the state in question to resolve the problem, rather than proceeding with its evaluation of the need for added federal regulation.(I)

Several commentators stated that the study should be performed by a credible body outside of EPA (the National Academy of Sciences was suggested).(I) If not performed by the NAS then it should be coordinated and/or peer reviewed by the NAS and EPA Science Advisory Board.(I) One person wanted to know what involvement the EPA Office of Research & Development will have in the study design.(I)

Other points made on the study's credibility were:

- EPA should utilize the resources of any of the large number of highly qualified consultants available in the field;(I)
- any areas of uncertainty raised during the peer review process or any segment of the study should be addressed and resolved;(I)
- the contractor that EPA selects to perform the study should have staff with experience in O&G operations and a reputation for credibility in its analysis;(I)
- the lack of readily available human health risk assessment information will require numerous assumptions and call into question the credibility of the results;(I) and
- there is a need to add quality assurance and quality control to the study.(2)

7. DATA COLLECTION

Several commentators raised issues regarding data quality objectives and quality control measures to ensure that the effort will be effective at answering the broad questions posed.(4) It was felt that given the uncertainty around the data quality and quantity, a need exists for a more iterative project design with targeted data acquisition efforts stemming from earlier phases of the study effort.(1)

Several commentators urged EPA to conduct public hearings and interviews to gather information.(2) They desired all allegations recorded during interviews to be documented and subjected to review by all parties, including appropriate state agency and industry experts.(1) Some in the audience questioned the ability of interviews to provide meaningful and consistent information.(1) They said industry should be allowed to submit any additional information relating to alleged incidents.(1)

Other commentators suggested that interviews with state and local agencies responsible for drinking water protection must include all agencies to which citizens are likely to complain, such as state environmental agencies, county health offices, etc.(2) Interviews should also seek to collect information on all alleged incidents of contamination or water loss, regardless of any cause determined by the investigating agencies.(1) With alleged incidents in hand, EPA can contact the complainants directly.(1) EPA should characterize the agencies' methods of recording and responding to complaints so that some assessment of the quality and completeness of agency files on complaints and investigations can be made.(1) Several commentators noted that voluntary disclosure of incidents by the industry are inherently suspect.(2) It is not sufficient to rely on an O&G agency's assessment of whether an incident has been resolved.(1)

Commentators wanted EPA to be as specific as possible in identifying dates and individual events, so that the potential for connection to HF can be investigated by all parties.(2) People wanted to know what sources and types of records will be evaluated in conjunction with anecdotal information collected during interviews.(2) One commentator proposed that the study design should clearly state that the investigation of incidents be restricted to citizen complaints alleging contamination or dewatering by CBM HF operations.(1) This commentator also suggested that in addition to information collected through an interview process, there must be a preponderance of geologic and engineering evidence that indicates HF is the most likely cause of a documented ground water contamination event before it is treated as an actual "incident."(1) Industry commentators underscored the need to collect balanced and complete data set prior to drawing conclusions.(3)

Several in the audience felt that significant research is needed to verify the source of a complaint:(4)

- screening is needed to substantiate complaints;(1)

- subjectiveness of accounts of contamination should be considered;(I)
- motivation behind some of the claims of contamination should be considered;(I)
- consider sometimes problems with well operation are reported as CBM complaints;(I) and
- define the objective criteria that will be used to evaluate alleged incidents.(I)

One commentator suggested that the study include an investigation of well construction deficiencies as a potential pathway for CBM to migrate into USDWs and to the surface.(I) This would include all wells, regardless of status, that penetrate but are not cemented through coal seams. Contamination of USDWs exposed in such wells may be due to annular migration of methane and/or natural gas originating in the coalbeds or gas-bearing formations, and not necessarily caused by fracturing of coalbeds in nearby wells. Thus, it may be important to examine this as a possible conduit for gas migration as well as fracturing of coalbeds. The USGS and BLM, as well as the state O & G agencies in CO and perhaps NM, have studied this issue and would be good resources for EPA.(I)

Another commentator stated that the vertical and lateral relationship of the target coalbeds (injection zones) to underground sources of drinking water must be described.(I) The characteristics and relationship of any confining beds to the target coalbeds and underground sources of drinking water must be described. The range of injection pressures used must be identified and the methods and considerations used by the industry to determine optimal pressure for gas production must be identified. Geologic conditions which should be considered for the protection of underground sources of drinking water when determining wellhead or bottom hole pressure must be identified.(I)

One individual noted that since the study is largely interview-based, it is not apparent how cause and effect relationships will be determined. The last Class V Well UIC rulemaking was underlain by an extensive survey effort, but using that study in the rulemaking effort was hampered by the absence of data linking activities with documented harm to drinking water supplies.(I)

A number of industry commentators requested EPA to conduct field tests and site visits.(4) The importance of looking at pre-job design, execution, and post-job analysis was noted, since reviewing field practices alone does not give an accurate account of the design and execution of a fracturing job.(I) The DOE facility in Wyoming has several hundred wells available to do research work in and would also be available for QA/QC input to the study.(I) One commentator thought EPA should drill wells and do its own fracs in a variety of areas in order to establish the scenario necessary to fracture out of zone and cause contamination to occur.(I) If this scenario proves to be nonexistent or very limited, then the risk posed by fracturing would be small and the need to further regulate unnecessary.(I) Another commentator suggested that every effort should be made to identify a safe “tracer” that is or can be incorporated into HF fluids and used to detect movement of fracturing fluids. Experiments should be conducted to measure the variability of HF fluid movement.(I)

One commentator asked if there is a correlation between proposed study areas and other CBM production areas with respect to subsurface geology, relationship between production and underground water resources, HF practices, and water quality of produced fluids. His point was that different regional locations may be appropriate to include in the study.(1)

It was mentioned that clusters of alleged incidents need site-specific field studies to verify whether the environmental impacts suggested are natural, caused by or exacerbated by CBM fracturing, or caused by other natural or man-impacted activities.(1) This effort should be peer reviewed.(1)

It was noted that one difficulty EPA will face in any future regulatory effort is having sufficient information to draw this one type of activity out from the background of activities that are impacting drinking water quality in coal mining regions.(1)

Several more questions were raised on data collection and use:

- How will incidents be quantified or estimated?(1)
- What data will be used to determine contamination and water loss?(1)
- What information will be collected to help link HF with an alleged incident?(1)
- What methods will be used to ensure that the study's objectives are clearly measurable?(1)
- What databases will be searched?(1)
- What technical literature will be collected?(1)
- What types of affected stakeholders will provide oral or written comments?(1)
- How will source bias be controlled?(1)
- How will the information collected be verified?(1)
- How will conflicting information be incorporated into a final document?(1)

Regarding the use of any data, commentators said input data should be based upon explicit field studies rather than incidental or theoretical data.(2) Databases of technical information are available through the O&G Boards, EPA Star Program, CBM associations, O&G associations, and the EPA CBM Outreach Program.(2) One commentator stated that companies have invested a level of resources in the technology of HF that could never be matched by EPA and the Agency would be challenged to conduct independent field tests on the technology without the industry's knowledge and support.(1)

Several industry representatives noted that extensive data on HF are already available.(4) A multimillion, multi-year program is ongoing to investigate possible CBM impacts in San Juan, CO, based on mapping, monitoring, and modeling.(1) In addition, IOGCC also has established baseline water quality conditions prior to CBM well drilling on numerous nearby lands. These data will be made available on its website: www.oil-gas.state.co.us.(1)

One commentator asked if research will be conducted into historical records to determine if water quality or quantity problems preceded coalbed methane development.(1)

It was noted that exhaustive and copious data exist among scholars, engineers, and industry.(2)

The validity of industry data was questioned by one commentator.(1)

One commentator asked about baseline information and noted the need to set real baselines prior to the start of the study.(1)

One commentator noted that use of GIS may aid in identification of incident clusters for site-specific investigations. Clustering of incidents can indicate geologic, hydrologic, hydrogeologic, and other factors that may influence incidents. Site-specific field studies are needed of all clusters to verify whether the environmental impacts suggested are natural, caused by, or exacerbated by CBM HF technology, or caused by other man-made activities.(1)

8. RISK ASSESSMENT

Considerable input was received on determining the relationship between impacts and HF activities. Some commentators said that the study should not start out with the assumption that a health threat exists from HF.(2)

Industry representatives identified a variety of potential circumstances and contaminant sources that they felt should be taken into consideration:(3)

- surface percolation;
- water well drilling and completion;
- naturally occurring materials found in elevated levels;
- other commercial or public activities;
- occurrence of iron bacteria in relation to drinking well water quality and relation to CBM complaints;
- work on wells by unauthorized people and introduction of fecal coliform bacteria leading to poor water quality;
- ground water interference with deep, long-wall mining, which may cause fractures and connection with the surface, and decrease water quality;
- cavitation procedures that dewater CBs not related to HF;
- occurrence of near-by strip mining for coal and relationship of strip mining to CBM complaints;
- increased use of more than one family on one well or water supply;
- increased residential development and competition for ground water supplies by neighbors;
- mechanical fatigue of pumps and pump water systems;
- improperly maintained pump and well systems;

- septic system contamination of ground water from onsite and offsite sources;
- poor well siting;
- fecal coliform and surfactants in ground water; and
- agricultural contamination (bad tastes, bacteria).

One commentator noted the importance of gathering information on the details of the fracture treatment relating to incidents potentially linked to HF.(I) Owners, operators, and/or contractors must be given the opportunity to provide information on:(I)

- make-up of the treatment fluid;
- intended extent of the treatment;
- actual results;
- post-treatment production;
- records of treatment fluid recovery; and
- volume of treatment.

Another commentator asked if the composition of fracturing fluids must comply with the MCLs established by EPA for public drinking water sources, then what risks exist?(I) It was suggested that EPA discuss the risks posed by HF of coalbeds in relation to other EPA programs under the UIC program.(I)

A discussion of risk included the following points:

- how will risk be defined;(I)
- how will incidents be used to define risk;(I)
- EPA must distinguish between risk factors and risk;(I)
- industry practices that may mitigate risk must be considered;(I)
- undertake a thorough risk analysis of the alternatives to methane gas production;(I) and
- abandoned and unplugged wells (e.g., core wells) must be included in the assessment of risk.(I)

On developing an incident rate:

- information is needed on the total number of CBM wells fractured;(I)
- incident rate as a percentage of total wells fractured should be calculated;(I)
- incident rate of wells contaminated from all other types of well problems should be calculated;(I)
- compare incident rate for wells contaminated due to HF (if any) with incident rate for all other types of well problems;(I) and
- incident rates should be based solely on verifiable incidents of ground water contamination.(I)

Commentators made a number of points relating to the methodology to assess potential risk. In general, they felt risk must be assessed in the context of a thorough understanding of the HF process, especially water mechanics (including size, shape, and extent of fractures that are created during stimulation).(3)

Data entered into a risk assessment model should be based on explicit field studies, and not be incidental or theoretical.(1) Only demonstrated incidences of contamination resulting from HF of CBM wells should be used for the study.(2)

Commentators had the following concerns regarding the methods that will be used to determine cause and effect:

- proximity of an alleged incident to a CBM well is not a sufficient connection to warrant regulation;(1)
- if a causal connection is not established, there is little regulatory relief that EPA can offer;(1)
- linking the mechanism of fracturing to an alleged incident is excessive and goes beyond what needs to be done to eliminate HF as a threat to ground water;(1) and
- a statistical design approach must be taken when evaluating incidents in order to determine statistical significance when deriving causal relationships.(3)

It was noted that a general risk model approach may not be applicable to various geologic or hydrologic conditions. Selection of a risk assessment model should be peer reviewed.(1)

Several commentators asked what scientific methods for risk characterization will be used.(6) They said that EPA should clearly outline the benchmarks against which it will evaluate HF technology and the criteria that will influence the Agency's determination. EPA should carefully evaluate, and include in its revised study design, details of the approach that it plans to use for assessing potential risks to ground water from HF.(2)

The matter of who will calculate risks was brought up.(1) Several commentators felt the study should be conducted employing sound risk-analysis techniques and supervised by a professionally trained independent risk assessor.(2) If the study advances to theoretical risk assessments from any incident identification, sufficient industry expertise and operator experience must be included as part of the study to provide a complete and accurate picture.(1) It may be appropriate to have an independent organization recognized for their work in risk assessment (e.g., an academic group like Harvard's Public Health group) participate on a review panel for such an undertaking.(1) Human health risk assessment is likely to require numerous assumptions.(1)

Commentators said the study should include a calculation of incidence rates compared with all CBM wells using HF.(2) Occurrence (i.e., incidence rates) provide a key piece of information in determining vulnerability, but determination of "potential and actual risks" is a substantially more complex objective involving issues of consequence, mitigation, and severity of impact.(1)

9. COSTS

Several commentators said the study is too costly.(3) Some questioned the level of funding has EPA committed to this process.(2) It was noted that proper funding is critical to ensure that appropriate data are collected, validated, inputted, and calculated for risk.(1) Another person wondered whether the study is a productive use of government resources, and reiterated the need to document the basis for potential ground water contamination resulting from HF prior to imposing costs of the study on the private and governmental sectors.(1)

The following comments were made relative to the cost considerations on the study and HF issue:

- a cost/benefit analyses of HF should be done, and benefits considered in any risk analysis;
- costs of connection to PWS should be considered;(1)
- costs of added or duplicate regulations should be considered;(3) and
- regulation would make exploration projects uneconomical.(1)

Some commentators felt that the depletion of significant natural resources without significant investment to tax-based infrastructure was occurring.(2) One person called on EPA to take an integrated look at HF impacts on resources: gas, water, and people.(1) One commentator noted that the cost of implementation of new HF regulation by the states has been estimated by a prior survey and that no reference to this survey is included in the study.(1)

10. STAKEHOLDER INPUT

Regarding stakeholder input, commentators had the following input:

- the study process must be transparent and available to the public;(2)
- EPA should make a global effort to reach all CBM interest groups, including newspaper ads and informal public hearings;(2)
- the study should be open at all stages to all stakeholders;(2)
- stakeholders should be notified of all field studies and meetings, and have the opportunity to attend all field studies.(1)
- progress reports should be provided by EPA;(1)
- the web should be used as a platform for sharing information;(2)
- notices of the study should be posted in all local areas where CBM wells are drilled;(1)
- sufficient time should be allotted at each step of the study to incorporate comments from stakeholders;(1)
- agendas, transcripts, and background materials from meetings should be distributed to stakeholders;(2)
- copies of specific complaints/complaint letters should be posted on EPA's website;(1)
- alleged contamination reports should be provided without personal information;(1) and
- alleged contamination reports should be provided with personal information (names) included.(1)

Some commentators felt that following all revisions and comment, the final study design should be made publicly available.(3) They also felt that stakeholder input must be explicitly provided for during the study and prior to finalization.(2)

Several commentators said that EPA should identify all types of stakeholders and put together a list for notification.(3) Groups that specifically mentioned that they want to be stakeholders in the study were: State of West Virginia; National Ground Water Association; J.M. Huber, Corp.; and the American Petroleum Institute.

One commentator suggested that EPA talk to the Gas Research Institute.(1) IOGCC offered EPA the use of its web site to post information on the HF issue.(1) Another commentator recommended that EPA obtain the contractual assistance of Talib Syed to conduct the study.(1) Finally, one commentator requested that EPA contact Clay Ragsdale, an attorney from Birmingham, Alabama, who has previously advised EPA that he represents many clients who have lost their water supplies.(1)

This concludes the summary of public comment received on EPA's proposed study to determine the impact of hydraulic fracturing of coal bed methane wells on USDWs.

Following is a list of agencies, organizations, and businesses from which written comments were received:

- Alabama State Oil and Gas Board,
- American Association of Petroleum Geologists,
- American Petroleum Institute,
- American Water Works Association,
- BJ Services Company, Houston, TX,
- Chevron,
- Citizens Oil & Gas Support Center, Durango, CO,
- Coalbed Methane Association of Alabama,
- Colorado State Oil & Gas Conservation Commission,
- Colorado Oil & Gas Association,
- Cummings Drilling Co., Inc., W. Boyleston, MA,
- Cushing & Sons, Drilling Contractors, Keene, NH,
- Domestic Petroleum Council,
- Dominion Exploration & Production, Inc.,
- Dugan Production Corp.,
- EPA Region 8 UIC Program, Paul Osborne,
- EPA Region 8, Joyce Ackerman,
- EPA Region 9,
- Ground Water Protection Council,

- Halliburton Energy Services, Inc., Houston, TX,
- Independent Petroleum Assoc. of America,
- Interstate Oil and Gas Compact Commission,
- J.M. Huber Corporation,
- Kansas Corporation Commission,
- Kansas Department of Health and Environment,
- Legal Environmental Assistance Foundation (LEAF),
- Michigan Dept. of Environmental Quality,
- Nebraska Oil and Gas Conservation Commission,
- National Ground Water Association,
- National Stripper Well Association,
- National Water Works Association,
- Ohio Department of Natural Resources, Division of Mineral Resources Management,
- Ohio Oil and Gas Association,
- Pennsylvania Dept. of Environmental Protection, Bureau of Oil and Gas Management,
- Schlumberger Technology Corporation, Sugar Land, TX,
- Tasker's Well Company, Inc. Northwood, NH,
- Utah Dept. of Natural Resources, Division of Oil, Gas & Mining, and
- WOGCC, Casper, Wyoming.

Oral comments were received from the following meeting attendees:

- Mr. Bruce Berens, Staff Advisor
Chevron Companies
Houston, TX
- Mr. Kevin J. Bliss, Washington Representative
Interstate Oil and Gas Compact Commission
Oklahoma City, OK
- Mr. Pete Brown
Cimarron Production Company
Oklahoma City, OK
- Mr. David S. Browning, General Counsel
Schlumberger Technology Corporation
New York, NY

- Ms. Susan Coleman, President
Headwaters Association, Inc.
Oakwood, VA
- Mr. Jerry Elkins, Vice-Chair
Lonesome Pine Soil and Water District
Raven, VA
- Ms. Laura Elkins
Vansant, VA
- Ms. Michelle Evans, Federal Projects Manager
Interstate Oil and Gas Compact Commission
Oklahoma City, OK
- Mr. Brian C. Griffin, Secretary of Environment
Oklahoma Office of the Secretary of Environment
- Ms. Christine Hansen
Interstate Oil and Gas Compact Commission
Oklahoma City, OK
- Mr. John Johnson, Chief
Office of Oil and Gas
W. Virginia Division of Environmental Protection
- Ms. Gwen Lachelt, Executive Director
Citizens Oil & Gas Support Center
Durango, CO
- Mr. Dennis Lathem
Coalbed Methane Association of Alabama
- Mr. David Minor, Operations Manager
El Paso Production Company
Birmingham, AL
- Ms. Susan M. Ponce, Senior Counsel
Halliburton Energy Services, Inc.
Houston, TX

- Mr. Bob Redweik, Environmental Engineer
Shell
Houston, TX
- Mr. Brian R. Roosa, Deputy Director
State of Michigan's Washington, D.C. Office
- Mr. Greg Schnacke, Executive Vice President
Colorado Oil & Gas Association
- Mr. Carl Michael Smith, Secretary of Energy
Oklahoma Office of the Secretary of Energy
- Mr. Thomas E. Stewart, Executive Vice President
Ohio Oil & Gas Association
- Mr. William H. Sydow, Director
Nebraska Oil and Gas Conservation Commission
- Mr. William F. Whitsitt, President
Domestic Petroleum Council
- Mr. Robert T. Wood, CEO
Tom Joiner and Associates, Inc.
Tuscaloosa, AL

Oral comments were received from the following audioconference participants:

- Mr. David E. Bolin, Assistant Supervisor
Production and Engineering
Alabama State Oil and Gas Board
- Mr. Rick Cooper, Assistant Inspector
Virginia Division of Gas and Oil
- Mr. Harley Davis
Raven, VA
- Ms. Diane Davis, Program Support Technician
Virginia Division of Gas and Oil
- Mr. Mark Deering, Assistant Inspector
Virginia Division of Gas and Oil

- Mr. Gary Eide, Assistant Inspector
Virginia Division of Gas and Oil
- Dr. Dennis Goldman, Director of Science & Technology
National Ground Water Association
- Mr. Jay Henderson, Assistant Inspector
Virginia Division of Gas and Oil
- Ms. Regina Holbrook, Office Service Specialist
Virginia Division of Gas and Oil
- Ms. Anna Ruth Horn
Raven, VA
- Mr. Keith Jordan, Environmental Coordinator
Coastal Oil and Gas
Houston, TX
- Ms. Sheila McClanahan
Mavisdale, VA
- Mr. Jim McDonald
Northeast Water Production, Inc.
Sterling, MA
- Mr. Steve Mobley, Principal
Research & Planning Consultants
Austin, TX
- Mr. Donald F. Oltz, State Geologist/Oil & Gas Supervisor
Alabama State Oil and Gas Board
- Mr. Steven L. Prince, Executive Director
Castle Valley Gas Producers' Council
Price, UT
- Mr. Bernard Reilly
Dickensons County Citizens Committee, Inc.
Clinchco, VA
- Ms. Christine Reimer, Director of Government Affairs
National Ground Water Association

- Ms. Lydia Sinemus, Assistant Inspector
Virginia Division of Gas and Oil
- Mr. Robert Wilson, Director
Virginia Division of Gas and Oil